



# SAGE III in limb scatter mode

## Validation of retrieved ozone profile



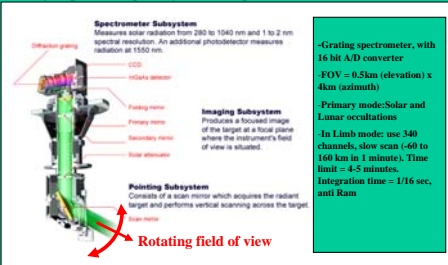
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### Purpose of research

- Analyze accuracy, precision and height registration of SAGE III Limb Scatter ozone products by comparing retrievals with measurements by other space instruments (SAGE II, HALOE, SAGE III(S), POAM III, OSIRIS), Ozonesondes and RAQMS model
- Ascertain potential of SAGE III in Limb Scatter mode to be used as risk mitigation for OMPS. SAGE III LS data (level 1 and level 2), together with lessons learnt (algorithm, forward model, sensitivity studies) will be applied to OMPS

### Stratospheric Aerosol and Gas Experiment (SAGE III)

SAGE III is the latest of the SAM / SAGE family of instruments which have been used in the past 25 years to profile Ozone, Aerosol and other trace gas species. Its primary mode of operation is Solar/Lunar occultation



### Ozone Mapping Profile Suite (OMPS)

- OMPS is comprised of three sensors:
- Nadir total ozone sensor (TOMS/OMI like)
  - Nadir profiler (SBUV like)
  - Limb profiler (new sensor, about 20 broad channels from 290 to 1000nm)

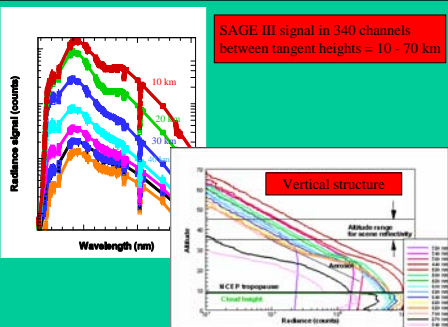
Planned to be on NPP and NPOESS satellites

### Outstanding issues with Limb Scattering method

To meet CDR requirements, OMPS needs 10% accuracy, 3% precision and 3-km vertical resolution over the critical 15-50 km altitude range.

#### Major issues:

- Straylight (large dynamic range across limb)
- Altitude registration (no target)
- Scene inhomogeneity
- Ozone horizontal gradients

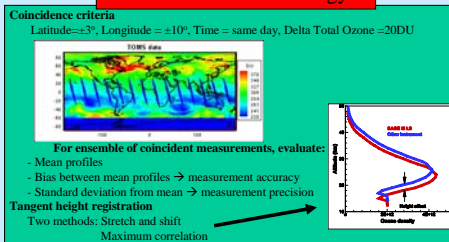


### Limb scatter data analysis. Straylight and retrieval method

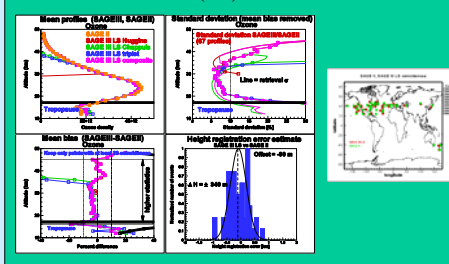
Reference: D. Rault, JGR, May 2005

- Straylight, dark current: High altitude (H>70km) radiance, MLR residuals
- Altitude registration: RSAS (350nm) and Knee (300-312nm)
- Gas (Ozone, NO<sub>2</sub>) retrieval: Multiple Linear Regression, Triplets (Huggins and Chappuis bands for Ozone, 430-450nm for NO<sub>2</sub>)
- Cloud height: Structure in radiance profiles (750,870,1020nm)
- Surface albedo: matching model to data above 35km (520,600,670,750,870,1020nm)
- Scene inhomogeneity: Straylight magnitude

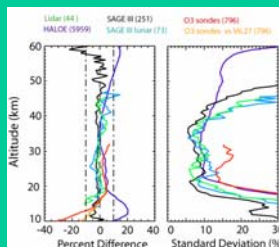
### Validation methodology



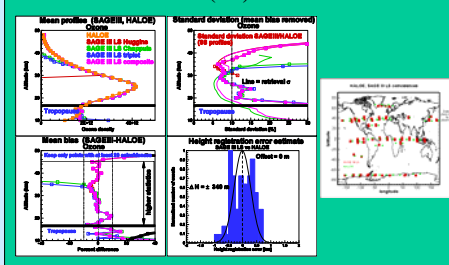
### SAGE III (LS) vs. SAGE II



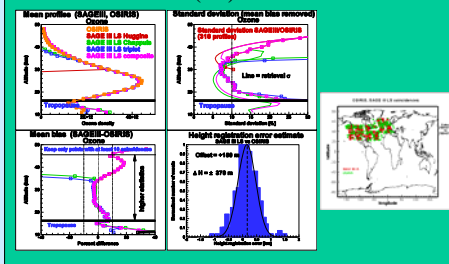
### SAGE II accuracy / precision for comparison



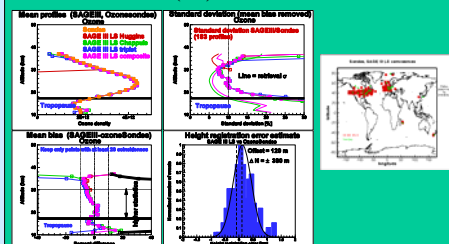
### SAGE III (LS) vs. HALOE



### SAGE III (LS) vs. OSIRIS

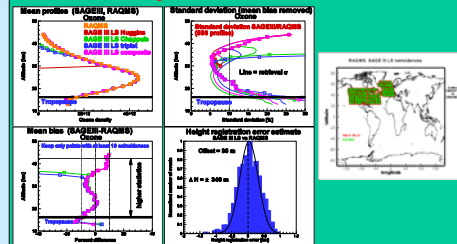


### SAGE III (LS) vs. Ozonesondes

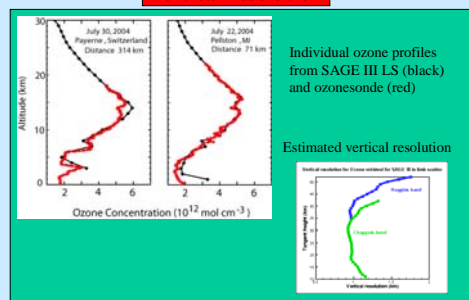


### SAGE III (LS) vs. RAQMS for July, 2004

RAQMS model computed at SAGE III LS geolocations  
RAQMS uses multiphase-mechanism data



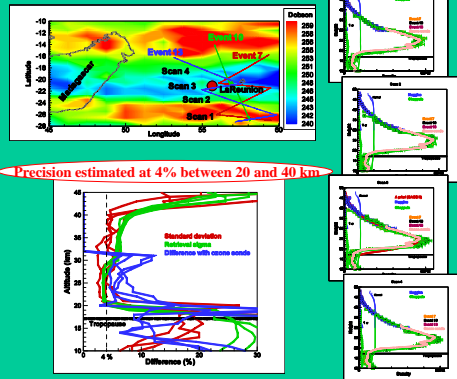
### Vertical resolution



### Additional precision analysis

Precision evaluated by repeated measurements over same geo-location

Precision = standard deviation



### Conclusion

- SAGE III LS Ozone products have been compared with retrieved profiles from SAGE II, SAGE III, OSIRIS, POAM III, HALOE, GOMOS and with Ozonesondes and the RAQMS model
- Results show accuracy of about 5% from tropopause to 45 km, precision of at least 5-10 %, from 20 to 35km (could be 4% from 20 to 40km), with height registration rms errors on the order of 350m
- Vertical resolution is at least 1.5-2 km
- Further work needs to be done
  - Validate NO<sub>2</sub> retrieval
  - Validate aerosol retrieval
- SAGE III LS data (level 1 registered radiances) and level 2 retrieval products (ozone, NO<sub>2</sub>, aerosol, scene albedo, cloud height), together with lessons learnt (algorithm, forward model, sensitivity studies, straylight) can now be applied to OMPS
- The SAGE III instrument is available to be used in the future for targeted studies: effect of clouds on height registration, effect of zenith angle on retrieval accuracy, effect of scene inhomogeneity, albedo...

### Acknowledgments

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